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Wendt

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(54) **ELECTRICAL CONNECTION TERMINAL**

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(30) **Foreign Application Priority Data**

Jul. 4, 2011 (DE) 10 2011 106 432

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H01R 4/52 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 4/5008*** (2013.01); *H01R 4/52* (2013.01)

(58) **Field of Classification Search**
CPC H01R 4/5008; H01R 9/24
USPC 439/441, 709
See application file for complete search history.

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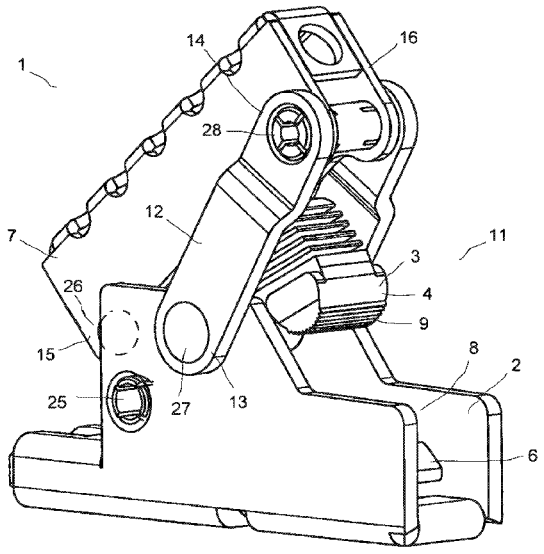
(57) **ABSTRACT**

An electrical connection terminal having a holder and a clamping lever pivotably arranged on the holder and having a clamping unit for clamping a conductor between the clamping unit and a current bar. A manual lever is provided which is pivotably accommodated on the clamping lever in order to enable a dynamic transformation ratio in the closing operation.

14 Claims, 5 Drawing Sheets



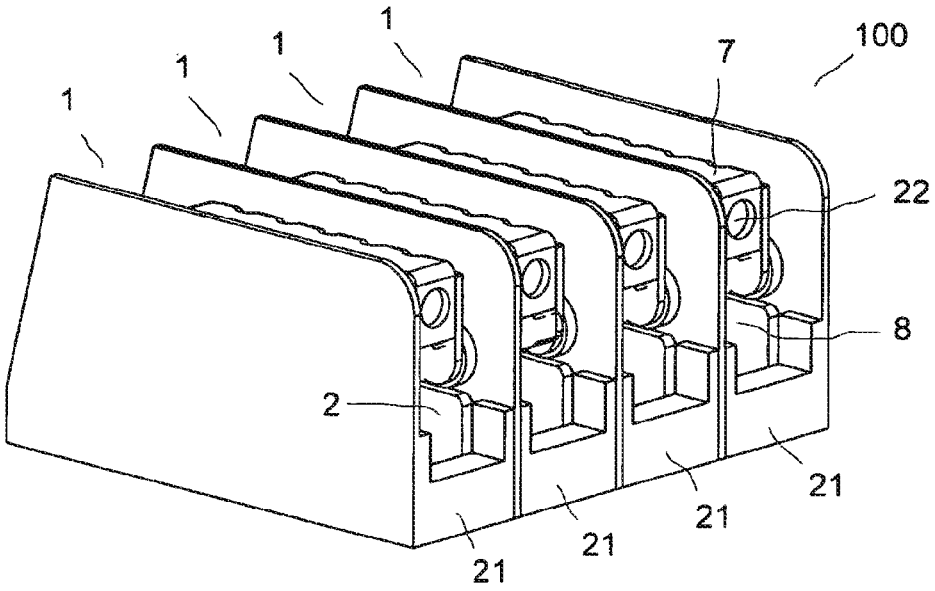


Fig. 1

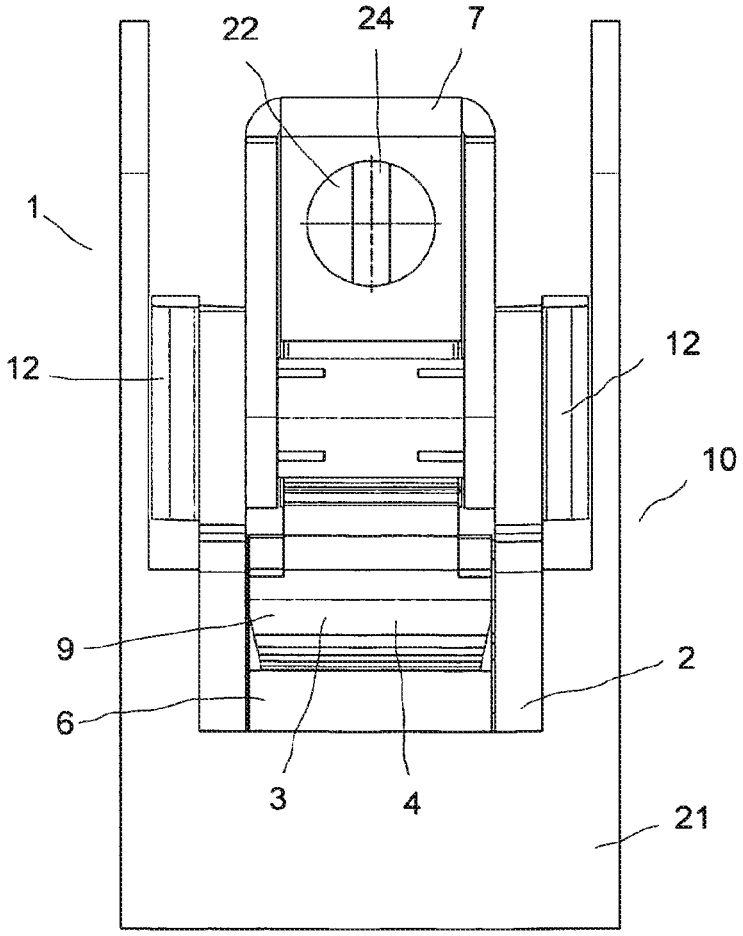


Fig. 2

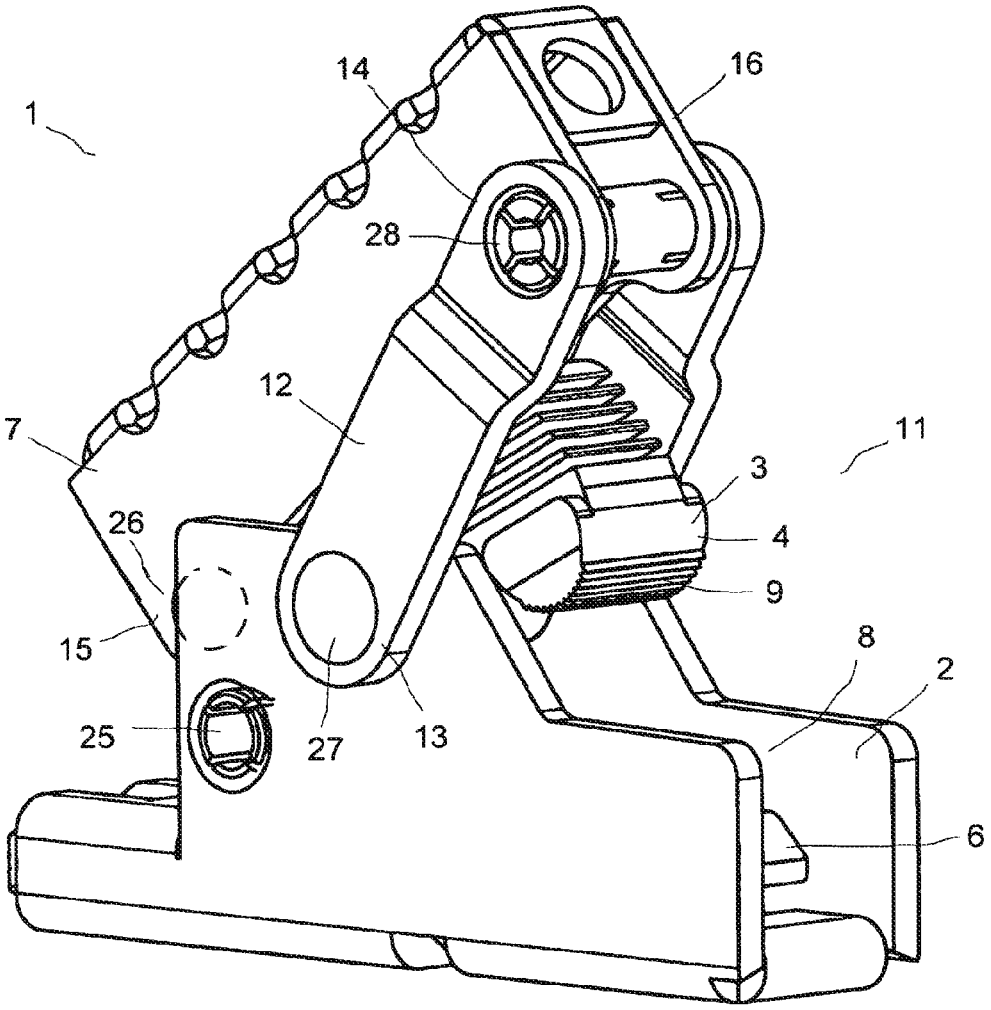


Fig. 3

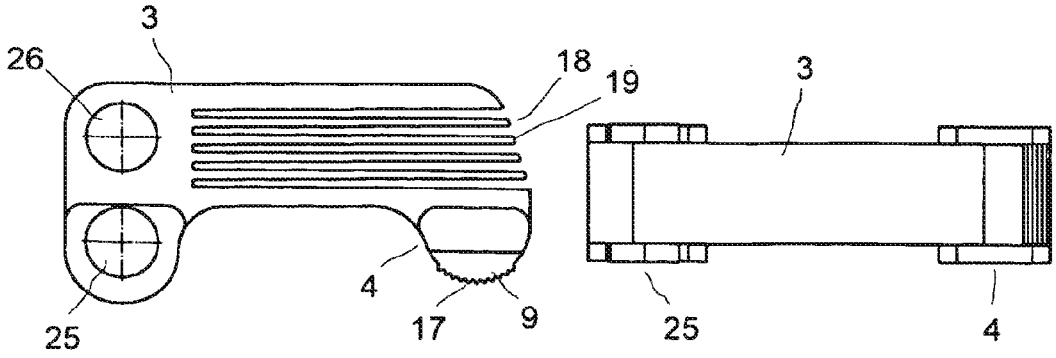


Fig. 4

Fig. 5

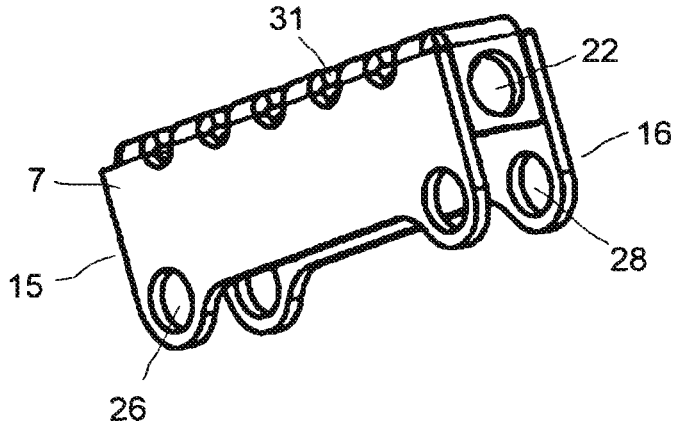


Fig. 6

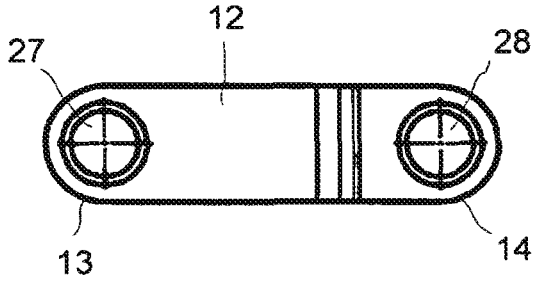


Fig. 7

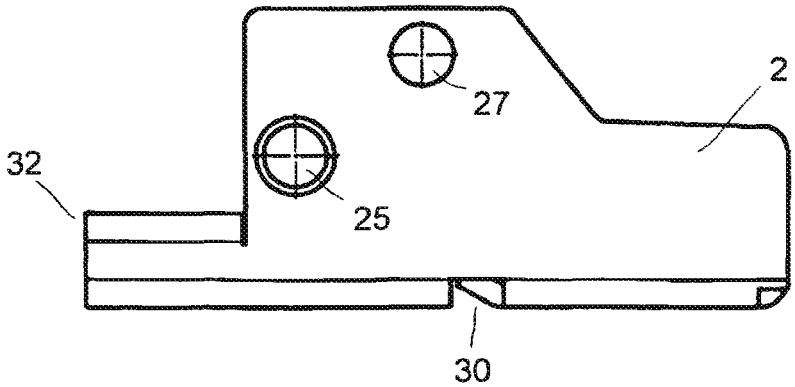
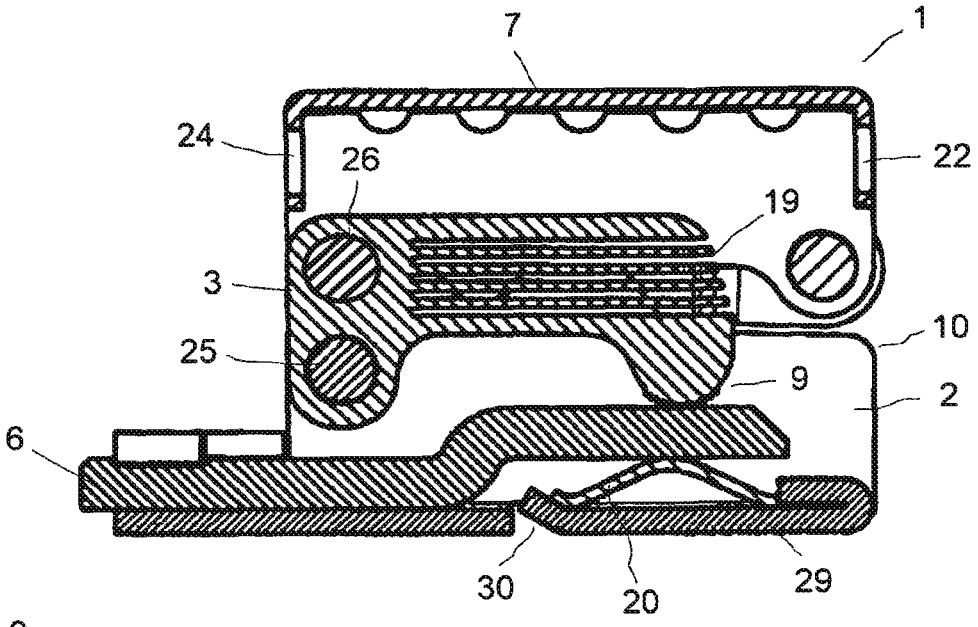


Fig. 8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1
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Fig. 9

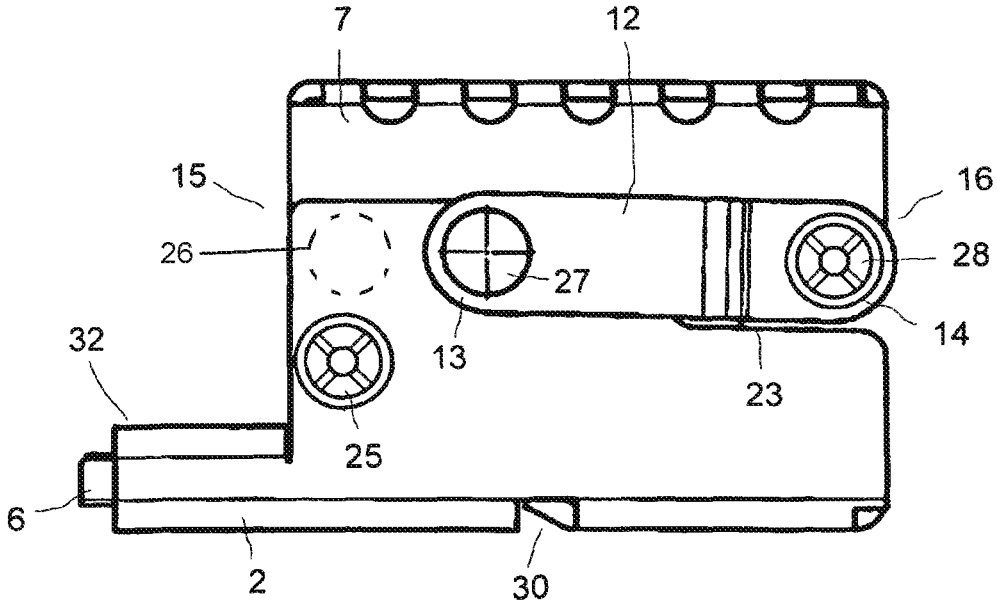
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Fig. 10

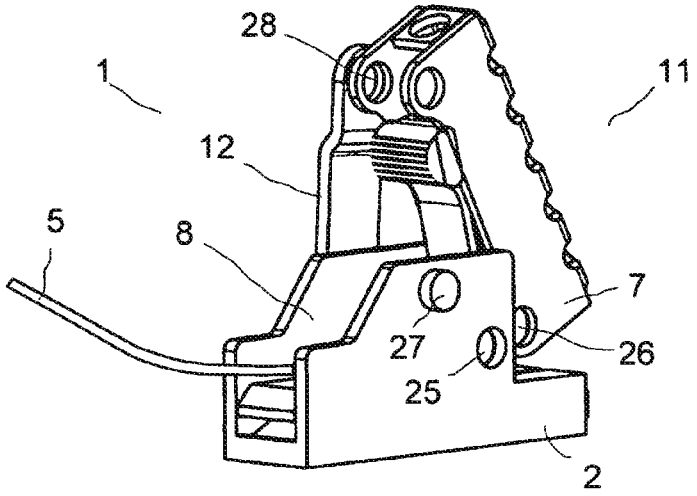

Fig. 11

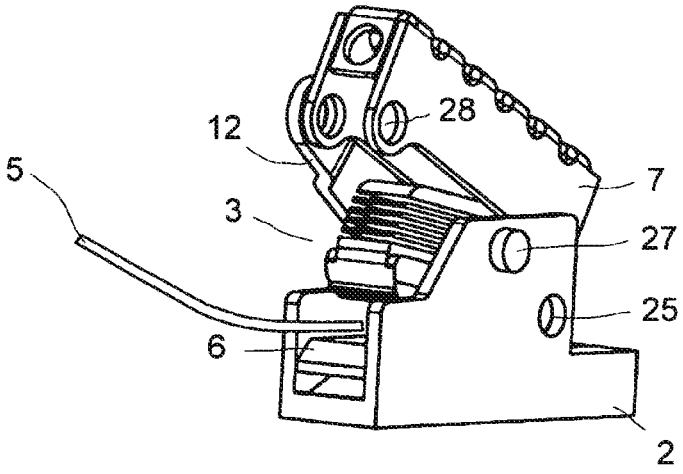

Fig. 12

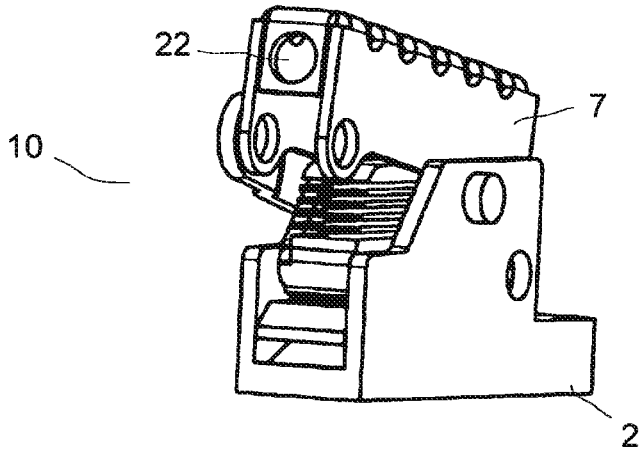

Fig. 13

ELECTRICAL CONNECTION TERMINAL

CROSS-REFERENCE TO RELATED APPLICATION

This application is the U.S. national phase of PCT Application No. PCT/EP2012/002564 filed on Jun. 18, 2012, which claims priority to German Patent Application No. 10 2011 106 432.3 filed on Jul. 4, 2011, the disclosures of which are incorporated in their entirety by reference herein.

The present invention relates to an electrical connection terminal, and in particular to a tilting lever terminal for the connection of a conductor.

Various electrical connection terminals which are suitable for the connection of conductors even of large diameter have been disclosed in the prior art. For example, it is possible to connect conductors even having large cross sections to screw terminals. The conductor in this case is firmly clamped to the electrical connection terminal via a screw connection. However, a disadvantage of such screw terminals is that a conductor from which the insulation has been stripped cannot readily simply be pivoted in from above. In particular, in the case of large conductor cross sections and conductors of solid design, this leads to the installation being made more difficult, since the conductor has to be bent over and has to be introduced axially from the front into the screw terminal.

By contrast, the installation is easier in the case of an electrical connection terminal which permits a conductor to be connected to be pivoted in from above. As a result, the conductor to be connected can be shortened to the appropriate length beforehand and can simply be pivoted in during the installation.

It is therefore the object of the present invention to provide an electrical connection terminal which is simple to install and permits a reliable contact connection of a conductor to be connected.

This object is achieved by an electrical connection terminal with the features of claim **1**.

Preferred developments of the connection terminal according to the invention are indicated in the dependent claims. Further advantages and features of the present invention emerge from the general description and from the description of an exemplary embodiment.

The electrical connection terminal according to the invention comprises at least one holder and at least one clamping lever which is arranged pivotably on said holder and has at least one clamping unit for clamping at least one conductor between the clamping unit and a current bar. A manual lever is provided, said manual lever being accommodated pivotably on the clamping lever in order to permit a dynamic transmission ratio during the closing operation and a high clamping force.

The electrical connection terminal according to the invention has a multiplicity of advantages since it provides a simple and flexible possibility of connection for electrical conductors and permits a secure contact connection. By means of the pivotably arranged clamping lever, it is possible widely to open the electrical connection terminal according to the invention such that an electrical conductor to be connected can be pivoted from above into the open connection terminal. The clamping state is subsequently brought about by pivoting of the clamping lever.

The interaction of the manual lever and of the clamping lever results in a dynamic transmission ratio, and therefore the lever transmission at the beginning of the closing operation already brings about a large movement of the clamping lever for a relatively small movement of the manual lever, whereas, at the end of the closing operation, a large movement of the manual lever leads only to a relatively small movement of the clamping lever. As a result, it is possible to transmit high clamping forces, and therefore even connecting conductors having large cross sections can be securely and reliably contacted.

In addition, it is possible reliably and securely to connect conductors of different cross sections.

In a preferred embodiment, the manual lever and the clamping lever are arranged in such a manner that self-locking of the clamping state is brought about. In this configuration, if the manual lever is transferred from the open state into the clamping state, a dead center is exceeded. In the clamping state, the manual lever is in such a position, in which first of all force has to be applied again in order to transfer the manual lever from the clamping state into the open state.

In particularly preferred configurations, at least one auxiliary lever is provided, said auxiliary lever connecting the manual lever pivotably to the holder. Two auxiliary levers are preferably provided, said auxiliary levers being arranged, in particular symmetrically, on both housing sides or on both sides of the holder. By means of the at least one auxiliary lever, a particularly effective transmission ratio and a dynamic change of the transmission ratio are possible.

Particularly preferably, one side of the auxiliary lever is held pivotably on the holder. Another side of the auxiliary lever is preferably connected pivotably to the manual lever. It is possible in this case for the pivot points of the auxiliary lever to be arranged in each case in the vicinity of the respective ends of the auxiliary lever. However, it is also possible for the pivot points on the one side and on the other side of the auxiliary lever to be at a considerable distance from the respective end of the auxiliary lever.

In particularly preferred refinements, the manual lever is connected pivotably at one end to the clamping lever and is connected pivotably at another end to the auxiliary lever. Within the context of the present application, the term "at the end" should also be understood as meaning a clear distance from the absolute end of the manual lever. Thus, distances of 20 or 30% of the entire length from the respective pivot point are possible. The overall length is determined here from the length required functionally for the pivoting movement and therefore the definition of the ends refers to the length required functionally for the pivoting operation.

Such a configuration, in which the auxiliary lever is connected pivotably at the sides or ends thereof to the holder or to the manual lever and in which the manual lever in turn is connected to the clamping lever and the auxiliary lever, results in a particularly advantageous embodiment which permits simple operation with very high clamping forces.

In preferred embodiments, the clamping unit comprises at least one clamping foot and/or comprises at least one clamping serration and/or at least one clamping point. For example, it is possible for the clamping unit to comprise a clamping foot or a plurality of clamping feet, wherein each clamping foot has a clamping serration or a plurality of clamping serrations which result in a particularly secure support of the clamped conductor at the electrical connection terminal. However, it is also possible for clamping points to be provided in addition to the clamping serrations or instead of the clamping serrations, said clamping points digging into the material of the conductor in order to achieve a high degree of security against being pulled out.

In all of the configurations, it is preferred for at least one spring device to be provided in order to counteract settling phenomena. It is possible here for the electrical connection

terminal itself or at least some parts or components thereof to bring about or at least to contribute to the spring action of the spring device.

The spring action of the spring device is particularly preferably at least partially produced by at least one component from a group of components, wherein said group of components comprises the holder and the manual lever and the auxiliary lever. For example, the entire spring action can be produced by the connection terminal itself and by the involved components without there being a spring, for example, in the form of a spiral or leaf spring or the like. The housing itself and the involved components of the electrical connection terminal provide a very high degree of spring rigidity which ensures reliable support even in the case of large conductor cross sections. Settling phenomena are reliably compensated for.

In preferred developments, it is possible and preferred for the spring device to have at least one clamping spring, wherein at least one clamping spring is preferably provided on the clamping unit. It is also possible and preferred for a plurality of clamping springs, which are designed in particular as leaf springs, to be provided on the clamping unit. Leaf springs of this type, in particular arranged in parallel, increase the spring force with increasing deflection, and therefore a greater spring force is applied in the case of large conductor cross sections than in the case of smaller conductor cross sections.

In addition to or instead of clamping springs on the clamping unit and in particular on the clamping foot of the clamping lever, at least one spring unit which in particular presses from below against the current bar can also be provided. For example, the clamping unit can be provided above the current bar and the spring unit can be arranged below the current bar. In such a configuration, pressure is exerted from above by the clamping unit on the conductor located between the clamping unit and the current bar, while the current bar is pressed against the conductor from below by the spring unit.

It is also possible for the conductor to be pushed in under the current bar, and therefore the current bar is pressed against the conductor by the clamping unit.

It is particularly preferred if the manual lever has a tool receptacle. For example, the manual lever can have an insertion opening for a tool, and therefore a tool, such as, for example, a screwdriver or the like, can be introduced into the manual lever. The effective length of the manual lever is thereby extended, and therefore a considerably greater force can be applied by the manual lever. At the same time, the operation is facilitated by introducing a tool into the manual lever.

In all configurations, it is preferred for the manual lever and/or the holder and/or the auxiliary lever to consist substantially or even entirely in each case of one or more bent metal strips. Such a configuration permits a stable construction of the connection terminal according to the invention, wherein the production is simple and cost-effective.

The holder preferably has at least one stop for the auxiliary lever and/or the manual lever. As a result, a defined closing position is provided, since the manual lever has to be moved until the auxiliary lever and/or the manual lever itself strikes against the stop of the holder.

It is also possible to provide at least one stop for the open state in order to limit the opening movement. In all configurations, it is particularly preferred for a high force transmission to be present at the end of the closing operation in order to transmit the force applied to the manual lever in a considerably boosted manner to the clamping lever.

The manual lever is particularly preferably accommodated on the clamping lever in such a manner, and the auxiliary lever is connected to the manual lever and to the holder in such a manner that a dynamic transmission of the displacement ratios takes place during the closing and during the opening.

In all configurations, at least one insulating layer and/or an insulating housing are preferably provided in order outwardly to insulate the electrical connection terminal.

The proposed electrical connection terminal provides a tilting lever terminal with a dynamic lever transmission, wherein, as the terminal is pivoted shut, the current conductor located in the connection terminal is pressed onto the current bar. The dynamic lever transmission means that, in an upper pivoting region in which a great force is not required, in particular a lever step-down ratio is provided. This means that a small pivoting movement of the manual lever brings about a relatively large pivoting movement of the clamping lever. In the region in which the conductor is clamped, a sliding lever transmission arises, and therefore a large pivoting movement of the manual lever brings about a relatively smaller movement of the clamping lever. In a corresponding manner, a greater compressive force is applied to the conductor. The use of spring elements permits a certain degree of elasticity in the construction and therefore also operation with different conductor cross sections. At the same time, the settling behavior of the conductor is compensated for. A secure clamped state is achieved by overcoming a dead center.

Further advantages and features of the present invention emerge from the description of the exemplary embodiment which is explained below with reference to the attached figures.

In the figures:

FIG. **1** shows a schematic illustration of a series terminal with a plurality of electrical connection terminals according to the invention;

FIG. **2** shows a front view of an electrical connection terminal;

FIG. **3** shows a perspective view of an open connection terminal according to FIG. **2**;

FIG. **4** shows the clamping lever of the connection terminal according to FIG. **3** in a side view;

FIG. **5** shows the clamping lever according to FIG. **4** in a top view;

FIG. **6** shows the manual lever of the connection terminal according to FIG. **3** in a perspective view;

FIG. **7** shows a side view of the auxiliary lever of the connection terminal according to FIG. **3**;

FIG. **8** shows the holder of the electrical connection terminal according to FIG. **3**;

FIG. **9** shows the electrical connection terminal according to FIG. **3** in a cross section in the closed state;

FIG. **10** shows a side view of the connection terminal according to FIG. **9** in the unsectioned state;

FIG. **11** shows the connection terminal according to FIG. **3** in a wide open state;

FIG. **12** shows the connection terminal according to FIG. **3** in a partially closed state; and

FIG. **13** shows the connection terminal according to FIG. **3** in a virtually closed state.

FIG. **1** shows a series terminal **100** according to the invention with a plurality of electrical connection terminals **1** according to the invention, which are each designed here as a tilting lever terminal and have dynamic lever transmission. Each individual connection terminal **1** has an insulating housing **21**, which can be designed as a single-part housing or else consists of a plurality of individual parts, in order to bring about the desired electrical insulation effect.

A manual lever **7** serves for actuating each individual electrical connection terminal **1**. In the clamped state, a conductor which is not illustrated in FIG. **1** is accommodated in a firmly clamped manner in the conductor receiving space **8**.

In order to actuate the manual lever **7**, a tool receptacle **22** is provided on the manual lever **7**. The tool receptacle here comprises an opening at the front end of the manual lever **7**, through which a tool, such as, for example, a screwdriver, can be introduced into the manual lever **7**. A slot **24** is provided at the rear end of the manual lever, said slot not being visible here in FIG. **1** and to which the tool can be fixed such that the manual lever **7** is moved by a pivoting movement of the screwdriver. As a result, considerably more force can be applied via the manual lever **7** than if a tool or a rod or the like were not introduced.

FIG. **2** shows a front view of an electrical connection terminal **1** according to the invention, which can be used individually or else is part of the series terminal **100** from FIG. **1**.

The connection terminal **1** is surrounded on the outside by the insulating housing **21**. The connection terminal **1** has a holder **2** on which a clamping lever **3** is pivotably arranged. The clamping lever **3** has a clamping unit **4** which here comprises a clamping foot **9**. With the clamping foot **9**, a conductor introduced into the conductor receiving space **8** is accommodated in a clamping manner between the clamping foot **9** and the current bar **6**.

As is visible in FIG. **2**, the manual lever **7** has a tool receptacle **22** with an opening through which the slot **24** at the rear end of the manual lever **7** is visible. A screwdriver introduced into the opening **22** can be latched into the slot **24** and therefore permits defined guidance of the manual lever **7** via the pivoting movement of the introduced screwdriver.

The manual lever **7** is connected here to the holder **2** via two auxiliary levers **12**. The function of said components is explained in more detail with reference to the further figures.

FIG. **3** shows a perspective view of a connection terminal **1** without the insulating components surrounding the connection terminal **1**. A current bar **6** is accommodated on the holder **2**. The clamping lever **3** is accommodated pivotably on the holder **2** via a pivot axis **25**. FIG. **3** illustrates a partially open state **11** in which the clamping lever **3** has been pivoted upward a considerable distance. The clamping lever **3** is pivotable via the pivot axis **25**.

A pivot axis **26** which is the rear pivot axis **26** of the manual lever is provided on the pivot lever **3**. In addition, the manual lever **7** is accommodated at the front pivot axis **28** so as to be pivotable in relation to the two auxiliary levers **12**. Each auxiliary lever **12** is accommodated on one side **13** on the holder **2** so as to be pivotable via the pivot axis **27**, while on the other side **14** of the auxiliary lever **12** the pivot axis **28** is provided as the front pivot axis of the manual lever **7**.

The overall result is four points of articulation via which four components, namely the holder **2**, the clamping lever **3**, the manual lever **7** and the auxiliary lever or the auxiliary levers **12** are connected to one another in an articulated manner. In this case, the distance between the pivot axes **27** and **28** of an auxiliary lever **12** is smaller than the distance between the pivot axes **26** and **28** of the manual lever **7**. The distance between the pivot axes **25** and **27** on the holder **2** is in turn greater than the distance between the pivot axes **25** and **26** on the clamping lever **3**.

A dynamic adaptation of the transmission ratio of the lever movement and of the lever forces is brought about by the selection of the geometry and of the individual lengths. At the beginning of the closing operation, a relatively small movement of the manual lever **7** brings about a relatively large closing movement of the clamping lever **3**, while, at the end of the closing operation, a relatively large movement of the manual lever **7** leads only to a relatively small closing movement of the clamping lever **3**, and therefore a high force transmission is achieved toward the end of the closing operation.

FIG. **4** shows the clamping lever **3** in a lateral illustration. The clamping unit **4** with the clamping foot **9** is arranged at the front end of the clamping lever **3**, wherein clamping serrations **17** are provided on the clamping foot **9** in order to increase the protection against being pulled out.

In order to achieve and reinforce a resilient action, a spring device **18** is provided here, said spring device having a plurality of clamping springs **19** which are designed here as leaf springs and extend parallel to one another.

The clamping lever **3** is provided pivotably via the pivot axis **25**, wherein a through hole is provided here in the clamping lever **3**. The pivot axis **26** for pivoting the manual lever **7** here comprises axle stubs on the outer side of the clamping lever **3**. Corresponding openings of the manual lever **7** are plugged onto said axle stubs in order to connect the manual lever **7** to the clamping lever **3** so as to be pivotable about the pivot axis **26**.

FIG. **5** shows a corresponding top view of the clamping lever **3**.

FIG. **6** shows a slightly perspective view of the manual lever **7**, wherein the bores or holes on the pivot axes **26** and **28** can clearly be seen. The pivot axis **26** is provided at the rear or one end **15** of the manual lever **7**, while the pivot axis **28** of the manual lever **7** is arranged at the front or other end **16**. The manual lever **7** consists here overall of a bent metal strip, but can also consist of different materials. In order to facilitate the bending process, holes **31** can be provided at the bending edges.

FIG. **7** shows a side view of an auxiliary lever **12**, in which the pivot axis **27** is provided on one side **13** or at one end, while the pivot axis **28** is provided on the other side **14** or at the other end. On the two pivot axes, holes are provided here in the auxiliary lever **12**, said holes being plugged onto corresponding axle stubs on the holder **2** and on the clamping lever **3** in order to connect the components to one another so as to be pivotable in relation to one another.

FIG. **8** shows a side view of the holder **2** which, instead of the pivot axis **25**, has a bore here, while, instead of the pivot axis **27**, axle stubs protrude laterally from the holder **2**. The current bar **6** is clamped at one end by a bent-over portion **32** of the holder.

The sliding stop **30** is explained with reference to FIG. **9**. FIG. **9** shows a cross section through a fitted connection terminal **1** in the clamping state **10**. The current bar **6** is secured by the bent-over portion **32** on the holder **2**. The clamping lever **3** is accommodated pivotably in relation to the holder **2** via the pivot axis **25**, and therefore, by means of a pivoting movement of the clamping lever **3** counter-clockwise, the clamping state **10** illustrated in FIG. **9** is departed from and the terminal is transferred, for example, into the open state **11** illustrated in FIG. **3**. The clamping springs **19** at the front end, where the clamping foot **9** is arranged, can be seen clearly.

The pivot axis **26** which, for the one auxiliary lever **12**, is located spatially in front of the sectional plane, and for the other auxiliary lever **12**, is located behind the sectional plane is shown here merely by dashed lines.

A spring unit **20** which presses from below against the current bar **6** is provided below the current bar **6**. The spring unit **20** is designed here as a bent sheet-metal strip and is clamped to the stop **29** by being bent over, while the spring

unit can slide resiliently upward over the slope at the stop **30** in order to produce the spring action.

FIG. **10** shows the unsectioned state of the connection terminal **1** according to FIG. **9** in the clamped state **10**.

In this state, the auxiliary lever **12** rests over part of the lever length thereof on the stop **23** of the holder. The stop **23** constitutes an end stop which defines the clamped state. In this position, a self-locking position of the manual lever **7** and of the clamping lever **3** arises. During the movement from the open state **11** into the clamping state **10**, a dead center is exceeded, and therefore, in order to release said state, effort is initially required.

The function of the electrical connection terminal **1** during the closing operation is explained with reference to FIGS. **11** to **13**.

FIG. **11** shows a wide open state **11** in which it is very simple to pivot in a conductor **5** to be connected from above. In this case, the conductor **5** does not have to be bent and introduced through a front opening but rather can simply be pivoted in from above into the wide open connection terminal **1** until the conductor approximately rests on the current bar **6**.

Subsequently, for example, after a tool is introduced into the tool receptacle **22**, the manual lever **7** is pivoted from the open state in the direction of the clamping state, as a result of which, initially in an accelerated manner, the clamping lever **3** is pivoted from the wide open state according to FIG. **11** into a partially open state, as illustrated in FIG. **12**.

For the sake of clarity, some components have been omitted in FIGS. **11** to **13**. In particular, only one of the auxiliary levers **12** is shown.

In contrast to the state illustrated in figure, in the state illustrated in FIG. **12**, the manual lever has been moved relatively little whereas the clamping foot **9** of the clamping lever **3** has already moved a considerable distance toward the current bar **6**.

During the further movement of the manual lever **7** in the direction of the clamping state **10**, the clamping foot **9** of the clamping lever **3** still only moves a relatively small amount, as a result of which a relatively high force transmission is brought about. The clamping force applied to the manual lever **7** is transmitted on an enlarged scale to the clamping foot of the clamping lever. As a result, high clamping forces are possible.

By means of the resilient action of the individual components, conductor cross sections of different size can be reliably and securely clamped, which permits a secure and simple operation of the electrical connection terminal **1**. The clamping springs **19** permit a defined spring action.

Separate latching is not required in the electrical connection terminal **1** since, by overcoming the dead center during the pivoting movement from the open state **11** into the clamping state **10**, self-locking is achieved.

List of reference numbers

Electrical connection terminal	1
Holder	2
Clamping lever	3
Clamping unit	4
Conductor	5
Current bar	6
Manual lever	7
Conductor receiving space	8
Clamping foot	9
Clamping state	10
Open state	11
Auxiliary lever	12
One side	13
Other side	14
One end	15
Other end	16
Clamping serration	17
Spring device	18
Clamping spring	19
Spring unit	20
Insulating housing	21
Tool receptacle	22
Stop	23
Slot	24
Pivot axis	25
Pivot axis	26
Pivot axis	27
Pivot axis	28
Stop	29
Stop	30
Hole	31
Bent-over portion	32
Series terminal	100

The invention claimed is:

1. An electrical connection terminal comprising a holder and at least one clamping lever which is arranged pivotably on said holder and has at least one clamping unit for clamping at least one conductor between the clamping unit and a current bar,

wherein

a manual lever is provided, said manual lever being accommodated pivotably on the clamping lever in order to permit a dynamic transmission ratio during the closing operation and a high clamping force

wherein

an auxiliary lever is provided, said auxiliary lever connecting the manual lever pivotably to the holder.

2. The connection terminal as claimed in claim **1**, wherein the manual lever and the clamping lever are arranged in such a manner that self-locking of the clamped state is brought about.

3. The connection terminal as claimed in claim **1**, wherein the auxiliary lever is held pivotably on one side on the holder and is connected pivotably on another side to the manual lever.

4. The connection terminal as claimed in claim **1**, wherein the manual lever is connected pivotably at one end to the clamping lever and is connected pivotably at another end to the auxiliary lever.

5. The connection terminal as claimed in claim **1**, wherein the clamping unit comprises at least one clamping foot.

6. The connection terminal as claimed in claim **1**, wherein at least one spring device is provided by the members of the 4-bar linkage.

7. The connection terminal as claimed in claim **6**, wherein at least one component contributes to the elastically biasing the clamping lever toward the current bar, wherein the at least one component is taken from a group of components consisting of the holder and the manual lever and the auxiliary lever.

8. The connection terminal as claimed in claim **1**, wherein the clamping unit is provided above the current bar, and further comprising at least one spring unit is provided below the current bar.

9. The connection terminal as claimed in claim **1**, wherein the manual lever has a tool receptacle.

10. The connection terminal as claimed in claim **1**, wherein at least one of the manual lever, the holder, and the auxiliary lever substantially consists of a bent metal strip.

11. The connection terminal as claimed in claim 1, wherein the holder has at least one stop for the auxiliary lever and/or the manual lever.

12. The connection terminal as claimed in claim 1, wherein there is a high force transmission at the end of the closing operation.

13. The connection terminal as claimed in claim 1, wherein the manual lever is accommodated on the clamping lever in such a manner, and the auxiliary lever is connected to the manual lever and to the holder in such a manner that a dynamic transmission of the displacement ratios takes place during the closing.

14. An electrical connection terminal comprising:

a holder;

at least one clamping lever which is arranged pivotably on said holder; and;

at least one clamping unit for clamping at least one conductor between the clamping lever and a current bar, wherein the at least one clamping unit comprises:

a manual lever pivotably connected to the clamping lever; and

an auxiliary lever pivotally connecting the manual lever to the holder, forming a 4-bar linkage in combination with the manual lever, the clamping lever and the holder;

wherein the 4-bar linkage can toggle between a clamped state with the clamping lever elastically biased toward the current bar, when the manual lever is in a lowered position, and a unclamped state when the manual lever is in a raised position, resulting in an a dynamic transmission ratio during the closing operation and a high clamping force.

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